THE OPTIMUM CONDITION TO ENHANCE DEGRADATION OF ORGANIC MATTER IN PALM OIL MILL EFFLUENT (POME) USING BIO MEDIA BIOREACTOR

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ABSTRACT

Bio media bioreactor is a combination of the concept of bio filter process and bioreactor. There are a number of small package treatment plants with different brand names currently available in the market in which different shaped plastic materials are packed as filter media and are mainly used for treating small amount of wastewater. Bio media or bio filter is effective in removing the organic substances that can cause the microbial growth after the POME treatment. Formulation of 1:9 *Pseudomonas putida* to POME, the bacteria was injected into the bioreactor. The optimum conditions for this treatment are where the aeration time (1L/min), rotational speed (180rpm), 100 percent supply of oxygen, and temperature of surrounding is at 37 ˚C. With those conditions, the results was obtained. The pH is between 7 to 9, the removal efficiency of chemical oxygen demand (COD) (46.73%), biochemical oxygen demand (BOD) (99.03%) and total suspended solids (TSS) (71.88%) of the treated POME. Therefore the POME should be treated by using biological treatment which is bio media bioreactor.

ABSTRAK

Bioreaktor bio media adalah gabungan konsep proses bio penapisan dan bioreaktor. Terdapat beberapa pakej kecil loji rawatan yang mempunyai pelbagai jenama di pasaran, di mana media penapisan dibungkus dalam pelbagai bentuk bahan plastik dan merupakan cara utama untuk merawat kuantiti air sisa yang sedikit. Bio media atau bio penapisan adalah berkesan untuk menyingkirkan bahan-bahan organik yang menyebabkan penumbuhan mikrob selepas rawatan efluen kilang minyak sawit (POME). Dengan nisbah 1:9 *Pseudomonas putida* kepada POME, bakteria disuntik ke dalam bioreaktor. Keadaan optimum untuk rawatan ini adalah di mana masa pengudaraan (1L/min), kelajuan putaran (180rpm), 100 peratus bekalan oksigen dan suhu sekitar pada 37 ˚C. Dengan keadaan seperti dinyatakan, hasil diperoleh untuk POME selepas rawatan adalah seperti berikut; bacaan pH adalah antara 7 ke 9, kecekapan penyingkiran keperluan oksigen kimia (COD) (46.73%), keperluan oksigen biokimia (BOD) (99.03%) dan jumlah pepejal tergantung (TSS) (71.88%). Oleh itu, POME perlu dirawat secara rawatan biologi dengan menggunakan bioreaktor bio media.

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LIST OF ABBREVIATIONS

AOB	Ammonia oxidizing bacteria
ASP	Activated Sludge Process
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
CPO	Crude palm oil
DOE	Malaysian Department of Environment
EFB	Empty fruit bunches
FFB	Fresh fruit bunches
HRT	Hydraulic retention time
MBBR	Moving Bed Biological Reactor
MBR	Membrane Biological Reactor
NH3-N	Ammonia- Nitrate
NOB	Nitrite oxidizing bacteria
O&G	Oil and grease
OD	Optical density
OLR	Organic loading rate
PAO	Polyphosphate accumulating organisms
PHA	Polyhydroxyalkanoates
POME	Palm oil mill effluent
SAF	Submerged Aerated Filter
TF	Trickling Filter
TKN	Total Kjedahl Nitrogen
TS	Total solids
TSS	Total suspended solids
UASB	Up-flow anaerobic sludge blanket

1 INTRODUCTION

1.1 Background

Oil palm (Elaeis guineensis) is one of the most versatile crops in tropical countries. Malaysia has a tropical climate and is prosperous in natural resources. Oil palm currently occupies the largest acreage of farmed land in Malaysia (Arif, S.,et al, 2001). The oil palm has a lifespan of over 200 years, while the economic life is about 20-25 years. The nursery period is 11-15 months for plants and first harvest is done after 32-38 months after planting. It takes 5-10 years for palm oil plant to reach peak yield (Kittikun, A.H., et al., 2000). Over the last four decades, the Malaysian palm oil industry has grown to become an important agriculture-based industry. Malaysian palm oil accounted for about 39% of the world palm oil production and 44% of world exports (Malaysia Palm Oil Council, 2010). The production of palm oil generates large amounts of polluted waste water known as palm oil mill effluent (POME). Raw POME usually has high in biochemical oxygen demand (BOD) (25,000 mg/L), chemical oxygen demand (COD) (53,630 mg/L), oil and grease (O&G) (8370 mg/L) and total solids (TS) (43,635 mg /L) which can cause significant environmental impact if it left untreated (Chan, Y.J et al., 2011). The raw or partially treated POME has an extremely high content of degradable organic matter. Even though POME is considered as non-toxic due to no chemicals were added during the oil extraction process, but it is identified as a major source of aquatic pollution by depleting dissolved oxygen when discharged the untreated into the water (Khalid and Wan Mustafa, 1992).

It has been reported that 3.5 m^3 of POME is generated for every ton of crude palm oil (CPO) produced while for fresh fruit bunches (FFB), it is about 0.7 m^3 POME/tonne FFB processed (Salmiati et al., 2006). The solid waste materials and other by-products generated in palm oil extraction process are as follows:

a) Empty fruit bunches (EFB) – 23% of FFB

b) Potash – 0.5 % of FFB

c) Palm kemel – 6% of FFB

d) Fibre – 13.5% of FFB and

e) Shell – 5.5% of FFB.

The EFB can be burn to produce potash which will be fertilizer by mulching. Both fibre and shell are used as boiler fuels while the palm kemel is usually sold to palm kemel oil producers for the extraction of the palm kemel oil (Thani et al., 1999)

This means that more than 15million tonnes of CPO had been produced annually for 500 palm oil mills. It is estimated that about 50 million m^3 of POME is generated from the palm oil industry annually (Salmiati et al., 2006). Therefore, a great action needs to be taken in order to guarantee the sustainable development in palm oil production.

1.2 Motivation

Due to the regrowth of the microbial mass after the POME has been discharge, the effluent is considered biologically not stable. Even though there is no evidence that shows the side effects of the treated effluent, it still cannot be assured to be safe to be release to water sources. The removal of the organic matters by using this process not only impairs microbial regrowth but also reduces taste and odour, the amount of organic precursor and other micro pollutants of health and aesthetic concern. Therefore the POME should be treated by using biological treatment which is bio media bioreactor. Bio media bioreactor is a combination of the concept of bio filter process and bioreactor. Originally, bio filter was developed using rock or slag as filter media, however at present, several types and shapes of plastic media are also used. There are a number of small package treatment plants with different brand names currently available in the market in which different shaped plastic materials are packed as filter media and are mainly used for treating small amount of wastewater. Bio media or bio filter is effective in removing the organic substances that can cause the microbial growth after the POME treatment (Chaudhary, D. S. et al., 2003).

1.3 Problem Statement

Ponding system and open tank digester are the most common POME treatment systems. More than 85 % palm oil mills use ponding systems because of their low cost (Ma A.N., 1999). However, these methods for treatment of POME have several disadvantages such as large areas of lands or digester are required and difficulty in collecting, utilizing the methane generated which causes a detrimental greenhouse effect to the environment and long hydraulic retention time (HRT). The other method to dispose the effluent is via land application system, thus providing essential nutrients for growing plants. It may a good choice yet looking at the rate of daily wastewater production, it is doubtful that the surrounding plantation can absorb all the treated effluent. Also a new technology under research is the zero waste evaporation technology. The water can be recovered by evaporating the POME while the residual solid content can be used as fertilizer yet it is not conventional because of high energy requirement (Ma A. N., 1996).

1.4 Objective of Research

To study the optimum condition to enhance degradation of organic matter in POME using bio media bioreactor in order to meet the Malaysian Department of Environment (DOE).

1.5 Scope of Research

The research focused on the laboratory investigations on optimum condition of high strength industrial wastewater namely palm oil mill effluent (POME) treatment using bio media bioreactor. The POME was taken from a palm oil mill in Malaysia. The study of effluent characteristics such as BOD, COD, and TSS has been done in the laboratory after the setup stage has completed. *Pseudomonas putida* will act as the bacteria that helps in the degradation of organic matters. Therefore, the research is to determine the optimum condition needed by *Pseudomonas putida* in bio media bioreactor in removing organic pollutants in POME.

2 LITERATURE REVIEW

2.1 Overview

This chapter presents the experimental studies of POME treatment using Pseudomonas putida in bio media bioreactor. Biological wastewater treatment is usually carried out by fungi, protozoa, algae, prokaryotes and rotifers may also be represented. POME is wastewater generated by the palm oil processing mills in Malaysia. Ponding systems and up-flow anaerobic sludge blanket are the common methods to treat POME yet there are some disadvantages. On the other hand in this research, bio media bioreactor is considerable relevance to the wastewater treatment.

2.2 Biological processes

Biological wastewater treatment is usually carried out by fungi, protozoa, algae, prokaryotes and rotifers may also be represented (Bitton, G., 2005). The microorganisms remove the nutrient and carbon from sewage by employing various metabolic and respiratory processes (Wagner, M., et al., 2002).

Wastewater is composed of organic material such as proteins, carbohydrates, fats and oils; nutrients such as nitrogen and phosphorus as well as trace amount of recalcitrant metals and organic compounds (Bitton, G., 2005). Biodegradable organic material is biochemically oxidised by heterotrophic bacteria under aerobic conditions resulting in production of water, ammonia, carbon dioxide and new biomass. Under anaerobic conditions methanogenic archaea, oxidises organic material to yield methane, carbon dioxide and new biomass (Madigan, M. T. et al., 2003).

Biological nitrogen removal can be achieved by a combination of nitrification, the oxidation of ammonia to nitrate, and denitrification, the reduction of nitrate to nitrogen gas. Nitrifying bacteria are chemolithotrophs, which use the inorganic nitrogen compounds as electron donors. Ammonia oxidizing bacteria (AOB) such as *Nitrosomonas, Nitrosospira* and *Nitrosococcus* will convert ammonia to nitrite according to the equation (1). Nitrite oxidizing bacteria (NOB) such as *Nitrobacter, Nitrospira, Nitrococcus* and *Nitrospina* will convert nitrite to nitrate consistent with the stoichiometric formula described by equation (2) (Henze M. et al., 2002):

$$15\ CO_2 + 13\ NH_4^+ \longrightarrow 10\ NO_2^- + 3\ C_5H_7NO_2 + 23\ H^+ + 4\ H_2O \quad (1)$$

$$5CO_2 + NH_4^+ + 10\ NO_2^-\ 2\ H_2O \longrightarrow 10\ NO_3^- + C_5H_7NO_2 + H^+ \quad (2)$$

The denitrification process reduces the nitrates to nitrogen gas which remove the nitrogen from the water phase. With the absence of oxygen denitrifying organism can respire membrane. Synthesis of the enzymes involved in denitrification is induced under anoxic conditions. With the presence of oxygen the aerobic electron transport system is employed since the redox potential of oxygen is higher than for nitrate.

The stoichiometric formula for overall process is presented below (Mateju, V., et al., 1992):

$$5CH_3COOH + 8\ NO_3^- \longrightarrow HCO_3^- + 2CO_2 + 6\ H_2O + 4\ N_2 \quad (3)$$

The ability to denitrify is common among hetereotrophic bacteria and archaea making it hard to determine which microorganisms are most important for in situ denitrification in wastewater treatment plants. Members of the genera *Pseudomonas, Alcaligenes, Actinetobacter, Bacillus, Paracoccus, Methylobacterium* and *Hypbomicrobium* are commonly identified as part of the denitrifying microbial flora in wastewater treatment plants when culture dependent isolation methods are used (Wagner M, et al., 2002).

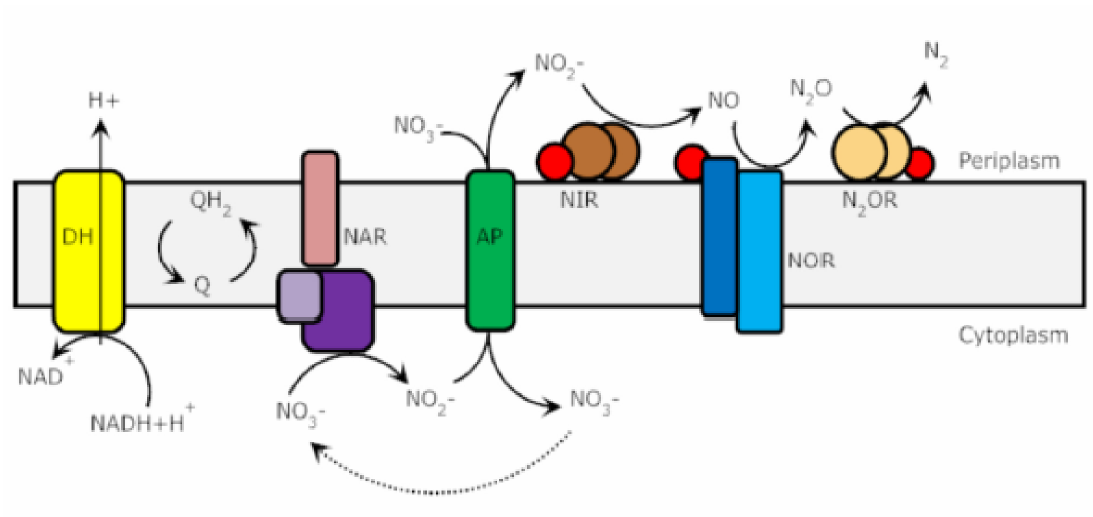

Figure 2-1: The enzymatic reactions involved in denitrification in bacteria.

Biological phosphorus removal is achieved by intracellular accumulation of polyphosphates in combination with cell uptake for growth. Polyphosphate accumulating organisms (PAO) is known as the most efficient phosphate removal bacteria. To obtain a high net uptake of phosphorus it requires alternating anaerobic and aerobic environment. The phosphorus content in bacterial cells is usually around 1-3 % of the dry weight while the corresponding percentage for PAOs can reach 10 % (Srivastava S., et al, 2005).

By removing biomass after the aerobic step, the phosphorus is removed from the wastewater. Traditional isolation procedures have failed to identify bacteria possessing the characteristics ascribed to PAOs. Instead, cultivation-independent molecular techniques have identified a group of *Rhodocyclus* related bacteria, Named "*Candidatus Accumulibacter phosphatis*", as PAOs (Oehmen, A., et al., 2007).

Some bacterial strains have been found to take in enhanced amounts of phosphorus under solely aerobic conditions. The possibility to by-pass the anaerobic step is advantageous from a process design point of view (Mbwele, L.A., 2006). Bacteria such as *Acinetobacter calcoaceticus, Acinetobacter iwoffi* and *Aeromonas hydrophila* are enhanced aerobic phosphorus uptake ability (Ghigliazza R., et al., 1998).

2.3 Palm Oil Mill Effluent (POME)

Besides palm oil and palm kernel, a palm oil mill also generates large quantities of liquid waste which is commonly referred to as palm oil mill effluent (POME). It has been reported that 3.5 m^3 of POME is generated for every ton of crude palm oil (CPO) produced while for fresh fruit bunches (FFB), it is about 0.7 m^3 POME/tonne FFB processed (Salmiati et al., 2006). Table 2-1 show the typical characteristic of typical POME.

Table 2-1: Characteristic of raw POME

Parameter	Value	Ma A. N. (2000)
Biochemical Oxygen Demand BOD3; 3days-30ºC	25,000	
Chemical Oxygen Demand (COD)	50,000	
Total Solids (T.S)	40,500	
Total Suspended Solids (T.S.S)	18,000	
Oil and Grease (O&G)	4,000	
Ammonia- Nitrate (NH3-N)	35	
Total Kjedahl Nitrogen (TKN)	750	
pH	4.7	
Temperature (ºC)	80-90	

* All values except pH and temperature are expressed in mg/L; POME= Palm Oil Mill Effluent

The palm oil mill effluent (POME) should meet the discharge limit stated by Malaysian Department of Environment (DOE). In year 1978, there is an enactment of the Environmental Quality Regulations detailing POME discharge standards. The key parameter in the standards is BOD. With initial BOD of 25 000 ppm of the untreated POME, the load has been reduced to 5 000 ppm in the first generation of discharge standard and down to the present BOD of 100ppm. There are efforts are in progress to move down to 50ppm, and in places where discharge into water ways is needed, and research and development (R&D) is actively pursued to reduce the BOD load to 20ppm. (Malaysian Palm Oil Board, 2012). Table 2-2 shows the palm oil effluent discharge standards.

Table 2-2: Palm oil effluent discharge standards

Parameter	Std A	Std B	Std C	Std D	Std E	Std F (Malaysian Palm Oil Board,2012)
pH	5-9	5-9	5-9	5-9	5-9	5-9
BOD	5000	2000	1000	500	250	100
COD	10000	4000	2000	1000	-	-
TSS	1200	800	600	400	400	400
NH3-N	25	15	15	10	150	100
Total N2	200	100	75	50	-	-

*Units in mg/L except pH ** No discharge standard after 1984

2.4 Treatment Methods of POME

Over the past few decades, there are plenty of treatment methods introduced in Malaysia. There are advantages and disadvantages of each wastewater treatment method. Some of the methods that conventional methods are actually lacking in terms of treatment time, area required for treatment and facilities to capture biogas.

Ponding systems are the common treatment methods. It reliable, stable and cheap yet large areas of land are required, long hydraulic retention time (HRT) and there are no facilities to capture the methane gas (Chooi et al., 1984). The second one is fluidized bed. It is the most compact of all high rate process and it has a large surface area for biomass attachment yet it has high power requirements and it is not suitable for high suspended solid wastewaters (Jr et al., 1997). The third method is up-flow anaerobic sludge blanket (UASB). It is useful when it comes to treatment of high suspended solid wastewater but the performance is dependent on sludge settle ability and the foaming and sludge floatation at high organic loading rate (OLR)s (Lettinga, 1995). On the other hand in this research, bio media bioreactor is considerable relevance to the wastewater treatment as they offer the less greenhouse effect where the gas methane can be controlled. Also, the have lower maintenance cost. Besides, the treated water can be reused, typically for irrigation.

2.5 Bioreactor

The bioreactor configuration is for treatment of organic for example COD or inorganic such as ammonia and nitrate contaminants that present in wastewaters will operate efficiently while achieving the design performance objective (Sutton P.M., 2006).

Most common available options in the biological treatment processes of domestic sewage options are:

a) Trickling Filter (TF)

b) Activated Sludge Process (ASP)

c) Submerged Aerated Filter (SAF)

d) Moving Bed Biological Reactor (MBBR)

e) Membrane Biological Reactor (MBR)

Trickling filters are to treat particularly strong or variable organic loads. They are typically filled with open stone or synthetic filter media to which wastewater is applied at a relatively high rate. The design of the filters allows high hydraulic loading and a high flow-through of air. Air is forced through the media using blowers on a larger installations. The resultant liquor is usually within the normal range for conventional treatment processes (Warden Biomedia, 2012).

The activated sludge process (ASP) is an aerobic biological wastewater treatment process that uses microorganisms, including bacteria, fungi, and protozoa, to speed up decomposition of organic matter requiring oxygen for treatment. The microorganisms are thoroughly mixed with organics under conditions that stimulate their growth and waste materials are removed. It use a variety of mechanisms and processes to use dissolved oxygen to promote the growth of biological floc that substantially removes organic material. A portion of the settled sludge is returned to the aeration tank to maintain an optimum concentration of acclimated microorganisms in the aeration tank to break down the organics. It also traps particulate material and can convert ammonia to nitrite and ultimately to nitrogen gas under ideal conditions (Warden Biomedia, 2012).

Submerged Aerated Filter (SAF) is a well proven technology for wastewater treatment. Technology is seen as the simplest and most cost effective method of commercial and residential sewage or waste water treatment, particularly for small to medium sized treatment plants where available land is limited and where full time operational manning would be uneconomical. It has no moving parts within its main process zones, any serviceable items will be positioned to access easily without disrupting the ongoing sewage treatment particularly when using random filter media. Submerged Aerated Filter (SAF) technology is a process used to reduce the organic loading of residential and commercial sewage or waste water, and in doing so will reduce the Biological Oxygen Demand (BOD) and a significant quantity of Suspended Solids (SS), in other words it is used to substantially improve effluent discharge quality (Warden Biomedia, 2012).

Moving Bed Biological Reactor (MBBR) involves the addition of inert media into existing activated sludge basins to provide active sites for biomass attachment. This conversion results in a strictly attached growth system (Warden Biomedia, 2012).

Membrane Biological Reactors (MBR) includes a semi-permeable membrane barrier system either submerged or in conjunction with an activated sludge process. This technology guarantees removal of all suspended and some dissolved pollutants. The limitation of MBR systems is directly proportional to nutrient reduction efficiency of the activated sludge process. The cost of building and operating a MBR is usually higher than conventional wastewater treatment (Warden Biomedia, 2012).

2.6 Filter Media

Filter media Filter media is anything placed in a filter that changes the quality of water flowing through it. There are three type of filter media:

a) Biological

b) Mechanical

c) Chemical

All three types are recommended, but an effluent treatment plant needs to have biological filter at minimum. Surface area determined the efficiency of biological filtration. The larger the surface area it has, the better it is able to house bacteria. Thus the general rule of thumb to compare media is by its surface area.

The biological media wastewater treatment system is a compact biological purification system. It consists of two sections, which are one section with submerged filters and an aeration system and the other for sedimentation. Microorganisms will grow on the submerged bio-block filter and degrade the dissolved organic load. This is a media that should not be replaced unless it has become too clogged to function. Bio media are usually made up of recycled polypropylene. The function is to provide housing for beneficial bacteria where it will break down dissolved solids to a less toxic form. To ensure a high biological degrading performance, the retention time and biomass in digesting organic matter are increased. Besides, the media serve to distribute thoroughly the whole surface area and prevent bacteria from being washed off with the effluent. The bacteria will extract food which is ammonia or nitrate and oxygen from the water passing over them. When particulate matter gets into the media, decreasing water flow will causing bacteria in that area to die because lack of oxygen and food. The optimum environment temperature for bacteria used for biological filtration is above 55 °F (Warden Biomedia, 2012).

Even though plastic filter media do not have the extensive surface area, but they are unlikely to clog and rarely need replacing. This allows construction of modules of superior compressive strength and higher void-volumes necessary for stacking to heights not achievable with rock filters. Greater specific surface area makes higher organic loadings possible (Warden Biomedia, 2012).

The components of mechanical media are inert which mean it do nothing to interfere with water chemistry. This media is vital for the efficiency of biological media because of mechanically or physically strains solids. Mechanical filtration will removes unsightly particles including fish excrement, sludge, uneaten food, or dust. It only required a replacement when the media can no longer release all the dirt that it holds (Warden Biomedia, 2012).

Chemical media can be effective for an assortment of filtering purposes even though it is not used as often as biological or mechanical media. This media is available in a variety of materials that can remove one impurity or many (Warden Biomedia, 2012).

The chemical method of filtration removes dissolved particulates via activated carbons, resins, and other adsorbents. Chemical filtration media helps to maintain water quality as unwanted dissolved matter adheres to it. The two most popular forms of chemical media are activated carbon and resins. Protein foam skimming or oxidation with ozone are two other forms of chemical filtration (Warden Biomedia, 2012).

2.6.1 Type of Bio Media

There are a plenty type of bio media used in biological treatment. The common material used for bio media is polypropylene.

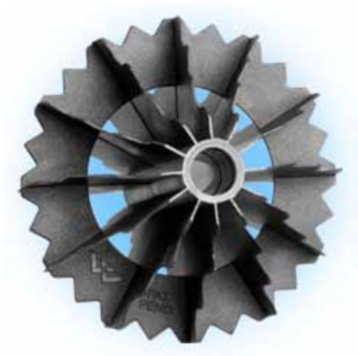

Figure 2-2: Bioball bio media

Figure 2-2 shows ball-like bio media. It has a spherical design and surface area of 220m²/ m³. The dimension of it is 65 x 53 mm and its voidage is 92%. The weight is 50 kg / m³ and it can hold until 530kg / m³. It is a perfect solution when surface area is more important than voidage (Warden Biomedia, 2012).

Figure 2-3: Biofil bio media

Figure 2-3 shows a similar design with the previous one but this one is suitable for applications where larger or greater voidage is required. It has surface area of 135 m^2 / m^3 and the dimension is 95 x 65 mm. The voidage for this bio media is 95%. The weight is 45 kg / m^3 and it can hold until 477 kg / m^3 (Warden Biomedia, 2012).

Figure 2-4: Biomarble bio media

Figures 2-4 shows another spherical design bio media and with surface area of 310m^2/m^3, it has the highest surface area of the three spherical designs in the bio media filter range. The dimension is 46 x 36 mm and the voidage for this bio media is 90%. The weight is 76 kg / m^3 and it can hold until 583 kg / m^3 (Warden Biomedia, 2012).

Figure 2-5: Bionet

Figure 2-5 shows the method of securing and installing the plastic random filter media in situ. This method is ideal for random media filtration control for water processing for municipal and package sewage plants. It has major long term health and safety benefits for staff both for initial installation and for longer term maintenance. It can use with Bioball, Biofil or Biomarble. It has a strength of 550lbs / m². The strength of the Bionet is 3 kn per 1000 kg (Warden Biomedia, 2012).

Figure 2-6: Biopipe

The Biopipe in Figure 2-6 is designed to provide a large protected surface area for the biofilm and optimal conditions for the bacteria culture when the media are suspended in water. A durable, rugged and highly efficient media for moving bed biological reactors (MBBR) and integrated fixed film activated sludge (IFAS) systems. Its innovative design creates a high percentage of protected surface area for microorganisms to adhere. In turn, this increases the overall biomass concentration and can reduce the tank volume required for wastewater treatment. Large openings allow for the wastewater to freely pass through the media which helps maintain a healthy and thin biofilm. It have surface area of 600 m^2 / m^3 and the dimension is 21.5 mmø x 13 mm and the voidage is 82.5%. The weight is 150 kg / m^3 (Warden Biomedia, 2012).

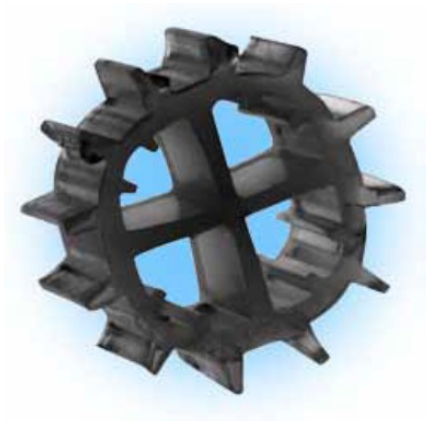

Figure 2-7: Biotube

Figure 2-7 shows tube shaped biological filter media with internal and external fins and surface area of $1000m^2/m^3$. The Biotube is designed to provide a large protected surface area for the biofilm and optimal conditions for the bacteria culture when the media are suspended in water. A durable, rugged and highly efficient media for moving bed biological reactors (MBBR) and integrated fixed film activated sludge (IFAS) systems. Its innovative design creates a high percentage of protected surface area for microorganisms to adhere. In turn, this increases the overall biomass concentration and can reduce the tank volume required for wastewater treatment. Large openings allow for the wastewater to freely pass through the media which helps maintain a healthy and thin biofilm. It have surface area of 1000 m^2 / m^3 .The dimension is 12 mmø x 8 mm and the voidage is 80%. The weight is 217 kg / m^3 (Warden Biomedia, 2012).

2.7 Microorganism

Microorganism is the organism that can live as unicellular or in colony cellular which is called multicellular. Due to the very small in size, it is required to use microscope to see the microorganism. The first microorganism was found by Anton van Leewenhoek in 1675 with his own microscope design. This discovery contributed to the microbiology subject and revealed the secret of decades where food can be poisoning, milk becoming a cheese, and grapes can turn into wine (Eddleman, 1997).

Microorganism can be divided into variety of groups which consist of bacteria, fungi, archaea, protists, microscopic plants like the green algae and in animal such as the planarian and plankton. Some of the microbiologists believe that virus is included but part of them are consider as non-living thing. On the other hand, sometimes one microorganism can be placed into many group since there are varies method to identifying microbe whether use temperature or being categorised into prokaryote or eukaryote group. Microorganism can be found in all part in biosphere since it can living in salt, fresh water, soil, desert, in the air or even in the earth crust. Besides the total number of microorganism in our body is exceed the number of the cell that built up our body. It is also reported around 200 miles per hour of microorganisms will leave the lungs when a human sneezes (Jim Deacon, 2003).

Microorganism can be divided into two parts whether it is pathogenic microbes or not. Pathogenic is the microbe that will bring the harm to human, plant and animal also the dieses while non-pathogenic is vice versa from it. This type microbe is depend to each other because the dieses is affect by pathogenic and non-pathogenic will react as a healer to heal the dieses which known as antibiotics. The production of microorganism can be from sexual and asexual reproduction. Sexual production is required both male and female microbe while asexual production is where one of the microbes for the cell division, mitosis to happen (Eddleman, 1997 & Deacon 2003).